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DATE: June 18, 2003

SUBJECT: EFFECTS OF MITIGATION MEASURES PROPOSED IN ATRAZINE INTERIM RISK MANAGEMENT DECISION ON EXPOSURE ESTIMATES

The U.S. EPA released a draft of its Interim Reregistration Eligibility Decision (IRED) for public comment on February 28, 2003 (U.S. EPA, 2003). The comment period on the IRED closed on April 29. The reregistration of atrazine is on a timeline set in a consent decree between U.S. EPA and several public interest groups. On this timeline, U.S. EPA agreed to complete the IRED by January 13 and to revise it by October 23, 2003. U.S. EPA intends to address environmental concerns in the revised IRED, which will contain new data from studies on atrazine effects on amphibians.

This memo summarizes occupational and residential exposure estimates in DPR's exposure assessment document (EAD) and the IRED. More scenarios were considered in the IRED than in the EAD; scenarios pertinent to atrazine use in California are discussed in this memo. Finally, mitigation measures proposed in the IRED are summarized, along with effects of those measures on exposure calculations.

Atrazine Use in California

Atrazine is a selective herbicide primarily used for weed control in a number of crops. Eight atrazine products are registered in California. Seven of the eight are flowable concentrate (FC) or water dispersible granular (WDG) formulations labeled for agricultural and commercial use, and the last is a granular formulation for application to lawns. There are two products named Aatrex 4L (and one named Drexel Atrazine 4L), which are FC formulations registered in California for use on corn, sorghum, pre-sorghum fallow, sugarcane, turfgrass, macadamia nuts, guava, and conifers. Two products named Aatrex Nine-O are WDG formulations registered for the same uses as the Aatrex products. Two products named Bicep II Magnum are FC formulations registered in California for use on corn, sorghum, and sudangrass. Finally, the granular product for lawn use is named St. Augustine Weed & Feed.

Atrazine in FC or WDG formulations may be applied aerially or with ground equipment; chemigation is prohibited. The granular formulation may be applied with a rotary or drop fertilizer spreader; application by hand is prohibited. Product labels direct users to broadcast applications on corn, sorghum, sugarcane, macadamia nuts, and conifers. Applications to guava

are as a directed spray, and turfgrass (for fairways, lawns, sod production and similar areas) applications may be on a per-acre or smaller area basis. This suggests the following handler scenarios for atrazine in California: mixer/loader (M/L) of FC in support of groundboom application; M/L of WDG in support of groundboom application; M/L of FC in support of aerial application; M/L of WDG in support of aerial application; M/L impregnating FC onto dry bulk fertilizers; application of impregnated dry fertilizer; groundboom applicator; aerial applicator; and flagger. For lawn care operators, mixer/loader/applicator (M/L/A) scenarios include use of backpack sprayers, low pressure handwands, hose-end sprayers; push type spreaders and belly grinders.

Post-application scenarios include reentry into each of the crops on which atrazine is used when foliage is present (sugarcane, turfgrass, macadamia nuts, and guava); reentry into areas where conifers have been treated (e.g., forested lands); and post-application activities on residential and ornamental lawns. Post-emergence applications to corn and sorghum occur when plants are less than 12 inches tall, suggesting that reentry exposures are not significant because potential for contact with foliage is minimal in these crops. Because applications to sugarcane are allowed until canopy closure, reentry for scouting or irrigation could result in contact with treated foliage.

According to the report released by DPR of pesticides sold in California, in 2001 a total of 90,719 pounds of atrazine were sold (DPR, 2002a). According to the 2001 Pesticide Use Report (PUR; DPR, 2002b), a total of 62,872 pounds of atrazine were applied for agricultural purposes. Comparison of these two numbers (with the caveats that the first is a sum of pounds sold and the second a sum of pounds used, and that products sold in one year might be used in another) suggests that approximately 70% of use in California in 2001 was for agricultural use, and about 30% was non-agricultural. Since 1993, annual reported use of atrazine in California has fluctuated, from a low of 36,078 pounds in 1995 (22,234 acres treated) to a high of 69,549 pounds in 1999 (39,881 acres treated; DPR, 2002b). In 2001, a total of 33,376 acres were treated in California, based on the PUR (DPR, 2002b). Again, these use totals do not include residential use.

Use sites given on product labels, along with atrazine use reported in 2001, are summarized in Table 1. Although atrazine is registered for use on macadamia nuts and guava, no use on these crops was reported from 1993 (as far back as was checked) to 2001. Scenarios involving these crops will be considered, however, as atrazine may be used on them in the future.

Table 1. Sites for which atrazine is registered in California, and use reported in 2001

Use site	Maximum Rate per Application [a]	Maximum Rate per Year [a]	Pre-Harvest Interval [a]	Pounds Applied in 2001 [b]
Conifers	4 lbs AI/acre	4 lbs AI/acre per year	3 or 7 months	29,248 [c]
Turfgrass	2 lbs AI/acre	3 lbs AI/acre per year	none given	19,000 [d]
Corn	2 lbs AI/acre	2.5 lbs AI/acre per year	none given	13,016
Sorghum	2 lbs AI/acre	2.5 lbs AI/acre per year	21 days	716
Sugarcane	4 lbs AI/acre	10 lbs AI/acre per crop	until close-in	290
Macadamia nuts	4 lbs AI/acre	no limit given	none given	0
Guava	4 lbs AI/acre	8 lbs AI/acre per year	none given	0

[a] From product labels. Rates are given as pounds active ingredient (AI) per acre.
[b] From the Pesticide Use Report (PUR; DPR, 2002b)
[c] Recorded in the PUR as "forest, timberland," and "christmas tree"
[d] Recorded the in PUR as "bermudagrass," "sudangrass," and "turf/sod"

EAD: Exposure Assumptions and Estimates

The exposure assessment document (EAD) for atrazine was completed in 1989 and revised in 1991 and 2000 (Sanborn, 2000). Estimates from the revised EAD were incorporated into the Rick Characterization Document (RCD; Gammon, 2001). In the EAD, a single exposure scenario was considered, handlers involved in a pre-plant application of atrazine to corn using groundboom. Exposure estimates for this scenario were based on three reports of a registrant's study in which 19 workers in Illinois, Indiana, and Ohio handled (all tasks were combined for estimate, based on a geometric mean of exposure monitoring data from study) 148 – 3,450 pounds of atrazine in several products that included both liquid and solid formulations (Selman and Rosenheck, 1996). Other studies were reviewed in an appendix to the EAD, but rejected as either using outdated techniques or unrealistic use conditions. Handler average daily dosages (ADD) were estimated at 1.77 – 6.07 µg/kg/day. Annual ADDs were estimated at 0.015 – 0.25 µg/kg/day, and lifetime ADD were estimated at 0.008 – 0.039 µg/kg/day.

No post-application or residential scenarios of any kind were addressed. Post-application scenarios were not considered based on label statements that atrazine is applied to soil long before harvest; thus, no foliar residues would be anticipated when workers were in the field (however, as noted in the last section, some applications might result in foliar residues that would be available to reentry workers). Residential scenarios were not considered because the granular product for residential use was not registered until October 2000.

In the RCD, margins of exposure (MOEs) were calculated using 5 mg/kg/day as the acute NOEL (based on developmental toxicity in rabbits, including skeletal variations, decreased fetal body weight and post-implantation loss and resorptions) and 0.5 mg/kg/day as the chronic NOEL (based on cardiotoxicity in dogs). MOEs based on "estimated 95th percentile" exposure ranged

from 55 to 580; all other MOEs (mean acute and all intermediate-term) were well above the target value of 100 (Gammon, 2001). Lifetime ADDs were used in the RCD to estimate carcinogenicity risk. Upper-bound increased lifetime risk was calculated between 9.6×10^{-7} and 1.2×10^{-5}.

IRED: Exposure Assumptions and Estimates

Residential scenarios: In the IRED (U.S. EPA, 2003), several residential use scenarios were considered, based on applications to turf (most turf uses are in southeastern states). A major assumption in the IRED was that there would be no long-term exposure in residential settings. Residential exposures are anticipated to last 1-30 days . Although turf residues have half-lives of up to 5 days (liquid) or up to 9 days (granular), and can take "up to several weeks" to dissipate (p. 28), handler and post-application exposures are expected to be less than 30 days because use directions allow a maximum of two applications/year on lawns (p. 27). As usual, residential exposure assessments assumed that residents wear short-sleeved shirts, short pants, shoes and socks, but no gloves (p. 28). Residents are not expected to have access to or expertise in use of protective equipment.

Five residential applicator scenarios were considered (p. 29):
1. M/L/A liquids using backpack
2. M/L/A liquids using low pressure handwand
3. M/L/A liquids using hose end sprayer
4. Loading and applying granulars using push type spreader
5. Loading and applying granulars using belly grinder

In addition, there were several post-application scenarios (p. 30).

For adults: turf contact, walking/golfing, push mowing lawn

For children: turf contact; hand to mouth activity (HTM); mouthing of turf or object; ingestion of soil; ingestion of granules; and combined HTM, mouthing, and soil ingestion.

Residential exposure estimates for handlers ranged from 0.22 – 96 µg/kg/day (p. 29). MOEs were based on a short-term NOEL of 6.25 mg/kg/day (based on delayed puberty in male rats), and for residential handlers were all above 300 (an additional FQPA 3X safety factor was added for residential exposures due to concern for the effect of the neuroendocrine mode of action on the development of the young), except for broadcast application of granular formulations with a belly grinder (MOE = 65). Residential post-application exposure estimates ranged 0.42 – 12 µg/kg/day for adults and 0.10 – 31 µg/kg/day for children (p. 30). MOEs for post-application exposures were all > 300 for adults; children's hand-to-mouth activities had MOEs around 200.

Occupational scenarios: For occupational exposures, U.S. EPA (2003) considered four formulation types: liquid; dry flowable (DF; this included WDG products); granular; and wettable powder (WP). A total of 16 agricultural occupational handler scenarios were considered (p. 37): M/L liquids in support of groundboom application; M/L DF in support of groundboom application; M/L WP in support of groundboom application; M/L liquids in support of aerial application; M/L DF in support of aerial application; M/L WP in support of aerial application; M/L liquids for rights-of-way application; M/L DF for rights-of-way application; M/L liquids into liquid and dry-bulk fertilizers; M/L DF into liquid and dry-bulk fertilizers; groundboom applicator; aerial applicator; rights-of-way sprayer; loader of granular formulations; applicator of granular formulations using tractor-drawn spreader; applicator of dry bulk fertilizer using tractor-drawn spreader; and flagger. Of these, three are not allowed in California (M/L of both liquids and DF for rights-of-way application, and rights-of-way sprayer). In addition, only three formulation types (FC, WDG, and granular) are registered in California; this deletes two more scenarios from our consideration. For lawn care operators, M/L/A scenarios covered use of backpack sprayers, low pressure handwands, hose-end sprayers; loader/applicator scenarios included push type spreaders and belly grinders.

Occupational post-application exposure following agricultural use was anticipated to be limited to a few activities, for the same reasons mentioned in the EAD. The following activities were considered in an earlier exposure assessment (U.S. EPA, 2001): scouting, irrigating and weeding in corn; scouting in conifer forests; pruning, scouting and thinning in Christmas trees; scouting sugarcane; scouting and irrigating sorghum; mowing, seeding, scouting, mechanical weeding, aerating, fertilizing, pruning, and transplanting golf course turf; mowing, scouting, mechanical weeding, irrigating, hand weeding, and harvesting sod; mowing, scouting and irrigating macadamia nuts or guava. All MOEs were > 100. These scenarios were not listed in the IRED, but were all reported as being below the level of concern (U.S. EPA, 2003).

Mitigation Measures Proposed in the IRED

Residential: Measures proposed to mitigate residential exposure risks are listed below.

- Restrict the application of granular lawn products when using hand-held devices to spot applications only
- Prohibit applications of granular lawn products by hand
- Reduce the maximum 1 time application rate for liquid formulations on lawns and turf to 1 lb AI/A from 2 lb AI/A
- Require that granular lawn products be watered in

Occupational: Measures proposed to mitigate occupational exposures are listed below.

Agricultural Handlers

- Require closed mixing and loading systems for the following scenarios:
  1. Mixing and loading liquid formulations for aerial application at a rate greater than 3 lb AI/A
  2. Mixing and loading dry flowable formulations for aerial application
- Require maximum PPE (long-sleeved shirt and long pants, shoes socks, and coveralls; gloves; protective eyewear (mixer/loaders) and a dust/mist respirator) for the following formulations:
  1. Liquids
  2. Dry Flowables
- Require that wettable powders be packaged in water soluble bags for both aerial and groundboom application.
- Require closed cockpits for aerial applications
- Restrict the impregnation of bulk fertilizer to commercial facilities (prohibit on-farm impregnation)
- Restrict the impregnation of dry bulk fertilizer to 500 tons per day for no more than 30 days per year
- Reduce the maximum application rate for handlers applying liquids with rights-of-way sprayers to 1.0 lb AI/A
- Require closed cabs for flaggers, in accordance with current agricultural practices.

Lawn Care Operators

- Require the use of baseline PPE (long-sleeved shirt and long pants, shoes and socks) for granular formulations
- Require the use of baseline PPE plus gloves for the following formulations:
  1. Water dispersible granules
  2. Water soluble powders
  3. Dry flowable
- Require the use of the maximum PPE (long-sleeved shirt and long pants, shoes socks, and coveralls; gloves; and a dust/mist respirator) for liquid formulations
- Reduce the maximum single application rate for liquid formulations on residential lawns and turf to 1 lb AI/A from 2 lb AI/A
- Require that granular lawn products be watered in

Table 2 shows handler exposures estimated with current labels and with proposed mitigation measures factored in. All estimates were based on data from the Pesticide Handlers Exposure Database (PHED, 1995), as the study used by Sanborn (2000) was considered to have too few replicates (19 workers were monitored for 2-3 days each) and too many variables (e.g., different formulations and different tasks, including M/L, M/L/A using open pour, M/L/A using closed system, M/L/truck tending, and applicator) to give a reliable exposure estimate for any single scenario. However, exposure estimates calculated using arithmetic means of exposure data from the study (according to current WHS policy for exposure estimates), rather than geometric means as used by Sanborn (2000), are actually higher than estimates calculated from PHED. This suggests that PHED does not overestimate exposure, at least for handlers involved in groundboom applications of atrazine to corn.

Protection factors (from the draft revised WHS exposure assessment guidance document, HS-1612) were applied as appropriate. To estimate exposure for mixing/loading liquids with a closed system, the appropriate PHED subset was used. PHED data are not available for mixing/loading dry flowables with a closed system; a 90% protection factor was applied to the open-system exposure estimates. Coveralls were assumed to cover all but feet and head, for a protection factor of 90%. Mitigation for pilots would require closed cockpits, gloves and a respirator. The PHED subset used to estimate pilots' exposures contains data from closed cockpit only; 90% protection factors were applied for gloves and respirator.

To determine how many months per year applicators would be exposed, PUR data were queried for 1998 – 2000 (UCD, 2003). Most counties reported use during just one to three months. Imperial County reported both aerial and ground use over the most months, four and five months, respectively (months with a single application were omitted). Ground applications to sudangrass in Imperial County occurred during two months per year, and were used to estimate seasonal and annual exposure of lawn care operators to atrazine. No data were available for incorporation into dry bulk fertilizer; this would be anticipated to occur only at the start of the growing season, however, and was assumed to occur during one month.

Table 2. Estimates of Pesticide Handler Exposure to Atrazine Based on Mitigation Measures Proposed in the Interim Reregistration Eligibility Decision (IRED) [a]

Work Task	Acute ADD (mg/kg/day)	SADD [b/] (mg/kg/day)	AADD (mg/kg/day)	LADD (mg/kg/day)
Aerial				
M/L - WDG [c]	3.19/**0.047**	0.797/**0.012**	0.266/**0.004**	0.142/**0.021**
M/L - FC [c/]	4.09/**0.049**	1.02/**0.012**	0.340/**0.004**	0.182/**0.022**
Applicator [d]	0.062/**0.038**	0.016/**0.010**	0.005/**0.003**	0.003/**0.017**
Flagger [e]	0.093/**0.009**	0.019/**0.002**	0.006/**0.001**	0.003/**0.0003**
Groundboom				
M/L - WDG [c]	0.911/**0.013**	0.182/**0.003**	0.076/**0.001**	0.040/**0.0006**
M/L - FC [c]	1.17/**0.014**	0.234/**0.003**	0.097/**0.001**	0.052/**0.0006**
Applicator	0.030/**0.010**	0.008/**0.002**	0.003/**0.001**	0.002/**0.0005**
Impregnating Dry Bulk Fertilizer				
M/L - FC [c]	1.17/**0.014**	0.234/**0.003**	0.019/**0.0002**	0.010/**0.0001**
Applicator	0.030/**0.010**	0.008/**0.002**	0.001/**0.0002**	0.0003/**0.0001**
Lawn Care Operator M/L/A [f]				
Backpack	0.129/**0.008**	0.032/**0.002**	0.008/**0.0005**	0.004/**0.0003**
LP handwand	0.094/**0.015**	0.024/**0.004**	0.006/**0.001**	0.003/**0.0005**
Hose-end sprayer	0.185/**0.078**	0.046/**0.020**	0.012/**0.005**	0.006/**0.003**
Push spreader	0.071/**0.023**	0.018/**0.005**	0.004/**0.001**	0.002/**0.0008**
Belly grinder	0.240/**0.108**	0.060/**0.027**	0.015/**0.007**	0.008/**0.004**
Residential M/L/A [f]				
Push spreader	0.069/**0.003**	NA [g/]	NA	NA
Belly grinder	1.51/**0.070**	NA	NA	NA

[a] New estimates (incorporating mitigation) in bold: old/new. Assumed measures listed in the IRED for dry flowable also apply to water dispersible granular (WDG).

[b] Seasonal Average Daily Dosage (SADD). Based on 1998 – 2000 PUR data, aerial season was estimated at 4 months; groundboom at 5 months; impregnating dry bulk fertilizer at 1 month; lawn care operator at 2 months.

[c] Mixer/Loader (M/L); liquid flowable concentrate (FC) and WDG: Closed system would be required (assumed 90% protection factor for M/L handling WDG, as no data were available). Additional personal protective equipment (PPE) required.

[d] Closed cockpit and gloves would be required. However, PHED subset contained data from closed cockpit only. CA law allows pilots in closed cockpit to omit gloves and respirator; new label assumed to superceded this and new PPE factored into exposure estimate (otherwise, no change to estimate).

[e] Flaggers must be in closed cabs; also new PPE requirements (see text).

[f] Mixer/Loader/Applicator (M/L/A): Decreased use rate; lawn care operators also have addition PPE.

[g] Not applicable (NA). Only two applications are allowed per year, at least two months apart.

Estimates in Table 2 were used, along with NOEL values in the RCD, to calculate MOEs for these scenarios before and after mitigation. The NOELs used were as follows: 5 mg/kg/day for acute exposures (based on developmental toxicity in rabbits), 1 mg/kg/day for seasonal (based on reduced maternal weight gain in rabbits) and 0.5 mg/kg/day for chronic (annual) exposures (based on cardiotoxicity in dogs). Using exposures calculated from current label conditions, most MOEs were < 100. Once the mitigation measures were factored in, only the following scenarios have MOEs < 100:

- M/L liquids in support of aerial applications (seasonal MOE = 83)
- M/L WDG in support of aerial applications (seasonal MOE = 83)
- M/L/A using hose-end applicator (acute MOE = 64; seasonal MOE = 50)
- M/L/A using belly grinder (acute MOE = 46; seasonal MOE = 37)
- Residential MOE using belly grinder (acute MOE = 71)

For carcinogenicity risk estimates, the LADD was multiplied by the maximum likely estimate (MLE) of 0.064 $(mg/kg/day)^{-1}$ and the upper bound (UB) estimate of 0.12 $(mg/kg/day)^{-1}$. All occupational applicator scenarios had increased risks > 1×10^{-6}, even after mitigation. Using LADD based on current label conditions, increased risk calculated from MLE ranged 1.9×10^{-5} to 1.2×10^{-2}; increased risk calculated from UB ranged 2.4×10^{-5} to 2.2×10^{-2}. Using LADD based on mitigation measures proposed in the IRED, increased risk calculated from MLE ranged 6.4×10^{-6} to 1.5×10^{-4}; increased risk calculated from UB ranged 1.2×10^{-5} to 2.9×10^{-4}. Because residential use is limited to at most two applications greater than two months apart, significant carcinogenicity risk was not anticipated.

Post-application exposure estimates are shown in Table 3. U.S. EPA (2001) used DFR from a study done in corn in their post-application exposure estimates. That study was apparently not submitted to DPR; because of this, I used the DFR values selected by U.S. EPA for reentry exposure estimates in sugarcane and conifers. A study of dissipation of turf transferable residue (TTR) following granular applications of atrazine was submitted to DPR (Rosenheck, 1999). In this study, TTR dissipation was determined in treated turf that had been irrigated, as well as in non-irrigated turf.

The only effect of mitigation measures on post-application exposure estimates is in residential lawns, where granular formulations are to be watered in after application. This decreases the TTR, resulting in much lower estimated exposures.

Table 3. Estimates of Post-Application Exposure to Atrazine Based on Mitigation Measures Proposed in the Interim Reregistration Eligibility Decision [a]

Scenario	Acute ADD (mg/kg/day)	SADD [b] (mg/kg/day)	AADD (mg/kg/day)	LADD (mg/kg/day)
Occupational				
Scouting, etc., sugarcane	0.077	0.002	0.0004	0.0002
Scouting, etc., turfgrass	0.001	0.0001	0.00001	0.00001
Scouting macadamia/guava	0.001	0.0001	0.000009	0.000005
Scouting conifers	0.038	0.001	0.0002	0.0001
Residential				
Reentry onto lawn (adult)	0.013/**0.004**	NA [c]	NA	NA
Reentry onto lawn (child)	0.021/**0.006**	NA	NA	NA

[a] New estimates in bold: old/new. Change affecting estimates: granular applied to lawn must be watered in.
[b] Seasonal Average Daily Dosage (SADD). Based on 1998 – 2000 PUR data, seasonal and annual exposure occur during 2 months in sugarcane, turfgrass and conifers and one month in macadamia/guava.
[c] Not applicable (NA). Only two applications are allowed per year, at least two months apart.

Using NOELs from the RCD, most MOEs were > 100. Only one scenario has an MOE < 100, scouting in sugarcane (acute MOE = 65). The exposure estimate was calculated based on an 8-hour workday; although we have no data on how long workers scout in sugarcane, it's unlikely that scouting is done for 8 hours in most crops.

Carcinogenicity risks were above the level of concern for most post-application scenarios (scouting in macadamia and guava was the exception). For occupational reentry, increased risk calculated from MLE ranged 3.7×10^{-7} to 1.3×10^{-5}; increased risk calculated from UB ranged 5.9×10^{-7} to 2.5×10^{-5}. Because residential use is limited to at most two applications greater than two months apart, significant carcinogenicity risk is not anticipated.

Scenarios of Concern

1. Mitigation measures proposed in the IRED (U.S. EPA, 2003) result in acceptable short- and intermediate-term risks, except for the following scenarios:

- M/L liquids in support of aerial applications (seasonal MOE = 83)
- M/L WDG in support of aerial applications (seasonal MOE = 83)
- M/L/A using hose-end applicator (acute MOE = 64; seasonal MOE = 50)
- M/L/A using belly grinder (acute MOE = 46; seasonal MOE = 37)
- Residential MOE using belly grinder (acute MOE = 71)

2. Mitigation measures proposed in the IRED are not sufficient to address cancer risks in most scenarios. The scenarios listed below all have cancer risk estimates greater than 1×10^{-6}:

- M/L WDG in support of aerial applications (MLE: 1.3×10^{-4}; UB: 2.5×10^{-4})
- M/L FC in support of aerial applications (MLE: 1.4×10^{-4}; UB: 2.6×10^{-4})
- Aerial applicator (MLE: 1.1×10^{-4}; UB: 2.0×10^{-4})
- Flagger (MLE: 2.0×10^{-5}; UB: 3.7×10^{-5})
- M/L WDG in support of groundboom applications (MLE: 3.8×10^{-5}; UB: 7.1×10^{-5})
- M/L FC in support of groundboom applications (MLE: 4.0×10^{-5}; UB: 7.4×10^{-5})
- Groundboom applicator (MLE: 3.5×10^{-5}; UB: 6.5×10^{-5})
- Impregnating dry bulk fertilizer with FC (MLE: 6.4×10^{-6}; UB: 1.2×10^{-5})
- Applying impregnated dry bulk fertilizer (MLE: 6.4×10^{-6}; UB: 1.2×10^{-5})
- M/L/A backpack (MLE: 1.2×10^{-5}; UB: 2.2×10^{-5})
- M/L/A low pressure handwand (MLE: 2.1×10^{-5}; UB: 4.0×10^{-5})
- M/L/A hose end sprayer (MLE: 1.1×10^{-4}; UB: 2.0×10^{-4})
- L/A push spreader (MLE: 3.3×10^{-5}; UB: 6.1×10^{-5})
- L/A belly grinder (MLE: 1.5×10^{-4}; UB: 2.9×10^{-4})
- Reentry activities in sugarcane (MLE: 1.3×10^{-5}; UB: 2.5×10^{-5})
- Reentry activities in turfgrass (MLE: 6.3×10^{-7}; UB: 1.2×10^{-6})
- Reentry activities in conifers (MLE: 6.7×10^{-6}; UB: 1.2×10^{-5})

References

DPR. 2002a. Report of Pesticide Sold in California: 2001. Sacramento, CA: Department of Pesticide Regulation.

DPR. 2002b. Pesticide Use Report, Annual 2001 Indexed by Chemical. Sacramento, CA: Department of Pesticide Regulation.

Gammon, D.W. 2001. Atrazine Risk Characterization Document. August 15, 2001. Sacramento, CA: Department of Pesticide Regulation, Medical Toxicology Branch.

PHED. 1995. The Pesticide Handlers Exposure Database, Version 1.1. Prepared for the PHED Task Force representing Health and Welfare Canada, U.S. Environmental Protection Agency, and the National Agricultural Chemicals Association; prepared by Versar, Inc., 6850 Versar Center, Springfield, VA 22151.

Rosenheck, L.A. 1999. Determination of Transferable Turf Residues on Turf Treated with Atrazine Applied in a Granular Fertilizer Formulation. Unpublished study submitted by Novartis Crop Protection, Inc. Novartis Study No. 805-98. DPR Volume No. 220-543.

Sanborn, J.R. 2000. Human Exposure Assessment for Atrazine. Revision No. 2, March 20, 2000. Sacramento, CA: Department of Pesticide Regulation, Worker Health and Safety Branch.

Selman, F.B. and Rosenheck, L. 1996. Evaluation of the Potential Exposure of Workers to Atrazine During Commercial Mixing, Loading, and Spray Applications to Corn. Unpublished study submitted by Ciba-Geigy Corporation. Lab Project No. ABR-95133. DPR Volume No. 220-464.

University of California – Davis (UCD). 2003. California Pesticide Use Summaries Database. Developed by UC Statewide IPM Project with data from the California Department of Pesticide Regulation. Website accessed for database queries on several dates. Available at: http://www.ipm.ucdavis.edu/PUSE/puse1.html.

U.S. EPA. 2001. Atrazine: Occupational and Residential Exposure Assessment and Recommendations for the Registration Eligibility Decision Document. DP Barcode D272008. January 18, 2001. Washington, DC: U.S. Environmental Protection Agency, Office of Prevention, Pesticides and Toxic Substances.

U.S. EPA. 2003. Interim Registration Eligibility Document: Atrazine. Case No. 0062. Approved January 31, 2003. Washington, DC: U.S. Environmental Protection Agency, Office of Prevention, Pesticides and Toxic Substances.